

**REPORT DOCUMENTATION PAGE**Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

**1. REPORT DATE (DD-MM-YYYY)**

25 April 2003

**2. REPORT TYPE**

Technical Abstract

**3. DATES COVERED (From - To)****4. TITLE AND SUBTITLE**

Simplified Liquid Rocket Engine Performance and Weight Model

**5a. CONTRACT NUMBER****5b. GRANT NUMBER****5c. PROGRAM ELEMENT NUMBER****6. AUTHOR(S)**

Eric Paulson, Wendel M. Burkhardt, Steve Mysko, Tim Jenkins

**5d. PROJECT NUMBER**

4847

**5e. TASK NUMBER**

0255

**5f. WORK UNIT NUMBER****7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**Air Force Research Laboratory (AFMC)  
AFRL/PRST  
4 Draco Drive  
Edwards AFB CA 93524-7160**8. PERFORMING ORGANIZATION REPORT NUMBER**

AFRL-PR-ED-AB-2003-104

**9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)**Air Force Research Laboratory (AFMC)  
AFRL/PRS  
5 Pollux Drive  
Edwards AFB CA 93524-7048**10. SPONSOR/MONITOR'S ACRONYM(S)****11. SPONSOR/MONITOR'S NUMBER(S)**

AFRL-PR-ED-AB-2003-104

**12. DISTRIBUTION / AVAILABILITY STATEMENT**

Approved for public release; distribution unlimited.

**13. SUPPLEMENTARY NOTES****14. ABSTRACT**

20030616 043

**15. SUBJECT TERMS****16. SECURITY CLASSIFICATION OF:****17. LIMITATION OF ABSTRACT****18. NUMBER OF PAGES****19a. NAME OF RESPONSIBLE PERSON**  
Sheila Benner**a. REPORT****b. ABSTRACT****c. THIS PAGE**

Unclassified

Unclassified

Unclassified

A

**19b. TELEPHONE NUMBER (include area code)**  
(661) 275-5693

FILE

MEMORANDUM FOR PRS (In-House/Contractor Publication)

FROM: PROI (STINFO)

25 Apr 2003

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2003-104**  
Eric Paulson (AFRL/PRST); Wendel M. Burkhardt, Steve Mysko & Tim Jenkins (all Advatech Pacific, Inc.), "Simplified Liquid Rocket Engine Performance and Weight Model"

2003 JANNAF CS/APS/PSHS/MSS Subcommittee Meeting  
(Colorado Springs, CO, 1-5 Dec 2003) (Deadline: 17 Apr 2003 - PAST DUE)

(Statement A)

**December 2003 CS / APS / PSHS / MSS**  
**ABSTRACT SUBMITTAL FORM**

**Unclassified Abstract**

*(250-300 words; do not include figures or tables)*

The Air Force Research Laboratory is developing a tool to analyze liquid propellant launch systems. This tool, called Integrated Propulsion Analysis Tool (IPAT), requires the capability to predict the weight of the vehicle components as well as the performance of the rocket engines.

For IPAT, a simplified model was developed to predict liquid rocket engine (LRE) performance and weight. The LRE model was developed to be very flexible and model a wide variety of rocket engines. The model allows the user to select the propellants used for the fuel and oxidizer from a list that includes hydrogen, hydrocarbons such as RP-1, storable propellants, and oxygen. The user can select the engine power cycle from a list that includes expander, staged combustion, gas generator, and pressure fed. Other parameters used by the model include engine thrust, chamber pressure, overall engine mixture ratio, nozzle exit area ratio, and materials of manufacture.

The model uses a combination of physical relationships and weight correlations to calculate the weight of individual rocket engine components. The model predicts liquid rocket engine performance using combustion gas properties provided by the Chemical Equilibrium with Applications (CEA) computer code.

This paper will describe the analysis approach used in the model and show comparisons of weight predictions to actual flight rocket engines.